Mineral Status in Relation to Rickets in Chakaria, Bangladesh

RM Welch[1], CA Meisner[2], N Hassan[3], JM Duxbury[4], M Rutzke[5], PR Fischer[6], A Rahman[7], JP Cimma[8], TO Kyaw-Myint[9], AL Kabir[10], K Talukder[10], DB Staab[11], S Haque[12], and GF Combs, Jr.[13]

Objective: Explore the aetiology of rickets in Chakaria and identify opportunities within the local food system to prevent the disease. The rickets prevalent among children of the Chakaria region of Bangladesh is not usually associated with vitamin D deficiency. Therefore, Ca-deficiency would appear to be at least a predisposing factor in its aetiology. That rickets has emerged as a public health problem in Chakaria within the last two decades suggests that changes in food habits and/or environmental exposures may have contributed to the disease either by reducing Ca intakes (e.g. reduced access to Ca-rich foods) or use (e.g. increased exposure to such Ca-antagonistic factors as Al, Pb, Cd, F, Sr, Ba, low P, low-B). The Chakarian food system has indeed changed during this time: winter rice (requiring irrigation during the dry season) has been introduced; shrimp production in flooded paddy fields has increased; deep tubewells have been drilled to provide potable water.

Methodology: Mineral analyses were done on samples of whole blood and foods collected from the Chakaria region in October 1997. Blood was obtained from children aged 36-98 months identified by their families as either rachitic (n=11) or unaffected (n=8), who were each given physical and radiographic examinations (results reported separately). Samples of drinking water from tubewell, cooking water (pond), and cooked and uncooked rice were collected from three households, one of which had rachitic children. Samples of other foods likely to be sources of Ca and other limiting nutrients (mungbean, grasspea, chickpea, Indian chickpea, cowpea, lentil, black gram, amaranth, red chillies, taro, a sea-fish, churie, shrimp, and faishya) were purchased from the market at Chakaria. Water pH was measured at the point of sampling; samples were held frozen (blood) or at ambient temperature (water), or dried (food) prior to analysis. Samples were digested with nitric-perchloric acids and analyzed for 20 elements (Pb, Cd, Cu, Zn, Co, P, K, Na, Mg, Fe, B, Mo, Ni, V, As, U, Cr, Al, Sr, and Ba) by inductively coupled plasma emission spectrometry.

Results: The results of the study showed blood mineral values for rickets cases and controls to be similar with the exception of P (serum: cases, 43 mg/L vs. control, 52 mg/L, $p>.05$; whole blood: cases, 216 mg/L vs. control, 235 mg/L, $p>.05$). All values in both pond and well water samples were within normal limits. All elements in the rice samples were within safe limits reported for plant foods; rice was very low in Ca (86 mg/kg as eaten). All elements in the local foods were within the normal ranges reported for these elements with two notable exceptions: amaranth and shrimp, both containing high concentrations of almost all elements (amaranth, mg/kg dry weight: Ca, 26,947; Al, 1455; Pb, 1.5; Sr, 129; Ba, 32; Cr, 9.8; V, 3; As, 0.2; shrimp, mg/kg dry weight: Ca, 37,278; Al, 209; Pb, 0.3; Sr, 322; Ba, 34; V, 0.5; As, 4.3).

Conclusion: The results do not indicate wide exposure to antagonists of Ca use, but point to a food supply generally low in Ca.

[1]U.S. Plant Soil Nutrition Lab, Cornell University, Ithaca, NY, USA
[2]CIMMYT, Dhaka, Bangladesh
[3]Institute of Nutrition and Food Science, Dhaka University, Dhaka 1000
[4]Department of Soil, Crop & Atmospheric Sciences, 235 Emerson Hall, Cornell University, Ithaca, NY, USA
[5]Department of Soil, Crop & Atmospheric Sciences, Cornell University,USA
[6]School of Medicine, University of Utah, Salt Lake City, UT, USA
[7]Society for Assistance and Rehabilitation of the Physically Vulnerable (SARPV), 1/2, Kazi Nazrul Islam Road, Block G, Mohammadpur, Dhaka 1207, Bangladesh
[8]Private Practitioner (Paediatrics), 6 Chemin des Violettes, 38640 Claix, France
[9]Health and Nutrition Section, UNICEF, Dhaka

[10]Institute of Mother and Child Health, Dhaka
[11]American Board of Surgery, P.O. Malumghat Hospital, Cox's Bazar, Bangladesh
[12]SARPV, Dhaka
[13]Department of Nutritional Sciences, 122 Savage Hall, Cornell University, New York, USA